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PAGURIDÆ AND COENOBITIDÆ

BY

E. F. THOMPSON, M.Sc.(N.Z.), Ph.D.(CANTAB.)

WITH THREE TEXT-FIGURES



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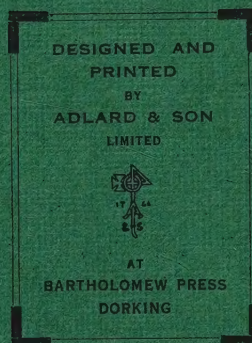
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WITH THREE TEXT-FIGURES.

INTRODUCTION.

THIS rather small collection consists of about 200 specimens ; of these I have referred 8 to two well-known species of Coenobita. The rest are Paguridae belonging to 13 genera and 24 species, one of which is described as new to science. Three specimens have been referred to the " Genus " *Glaucothoe* and seem to throw a little further light on the relationships of these animals.

Because the object of the Expedition was to investigate the fauna of the deep water, this collection is not truly representative of the Indian seas. This accounts for the fact that only two species of Coenobita were collected, and for the poor representation of several of the typically shallow-water genera of the Paguridae.

The stations at which Pagurids were taken are confined to the Gulf of Oman, the South Arabian coast, the Gulf of Aden, the East African coast, the Zanzibar Region, and the Maldiva area. That is, capture of Pagurids was confined to the coastal regions and to the two Gulfs. A similar state of affairs has been found by others who have reported on the bottom living forms from this expedition. It is tempting to take this as evidence that these forms do not occur in the main basins, but it is very doubtful whether this conclusion is justified, as the Expedition station list shows that there were only three fairly successful bottom collections made in these main ocean basins.

Of the species found, only five are represented by any number of specimens, and these five species include between them nearly three-quarters of the total number of specimens in the collection. The rest of the species are represented by only one or two examples often found at one station only. At Station 72, in the Gulf of Oman, almost a quarter of the total collection was obtained, and this included nearly a third of the total number of species, three of which were not found again by the Expedition. This merely serves to emphasize what has appeared from other deep sea expeditions, namely, that the species of the deep sea fauna are not, by any means, evenly distributed, even in the localities in which they are known to occur. This seems to be particularly true of the Paguridae. In view of this fact, the widespread tendency to use " negative " evidence in tracing the

distribution of deep sea forms, except where the number of samples is extremely large, is open to serious suspicion.

Alcock (1905) has considered the questions of the geographical distribution and affinities of the Pagurids of the Indian region at considerable length. In view of the smallness of the present collection and its unrepresentative nature, little can be added to Alcock's work. As that author has shown, the littoral and shallow water forms, while they have a large number of rather local and, presumably, recently evolved forms, are clearly related to those of the rest of the Indo-Pacific region. We can divide the deep water forms into those living at mid-depths, which have considerable affinity with the Pagurids of the North Atlantic: and the one truly abyssal form, *Parapagurus pilosimanus*, which is found at great depths round the edges of every ocean basin in the world.

It is of interest that the peculiar form, *Paguroopsis typica*, hitherto known from the Philippine Islands, the Gulf of Martaban and Cape Comorin, was found in the Zanzibar region, thus extending its known distribution another 2000 miles round the world. An interesting feature is that, although this species has such a wide geographical range, its recorded depth range, only 32 meters, is extremely narrow. Perhaps the general features of these faunistic relationships can be explained by the water movements.* Thus the surface waters of the Indian Ocean are strongly influenced by the monsoons. At the time when there is a rapid movement of this surface water across the Bay of Bengal into the North-west part of the Indian Ocean there is a flow across this ocean to the African coast, then clock-wise past the Gulf of Oman and on down the west coast of India. If we examine the species found in shallow water along this course, we see a gradual reduction in the number of species which are identical with the fauna of the rest of the Indo-Pacific, and an increase in the number of species which are not found in the rest of the Indo-Pacific but have closely related forms there. The Bay of Bengal seems to show a similar change as we pass round it in an anti-cyclonic direction.

The hydrographic evidence seems to suggest that the waters of this area at mid-depths are, at least in part, derived from the corresponding layers in the Atlantic Ocean, and that the mid-waters of the Indian Ocean, in turn, supply those of the Pacific. Perhaps this may, in part, explain the unmistakable Atlantic facies of the north-west Indian Ocean Pagurid fauna of mid-depths. Perhaps the universal distribution of *Parapagurus pilosimanus* can be attributed to the world-wide and fairly direct supply of this bottom water in all the oceans of the world. Such a suggestion should not be taken too seriously. As the rate of movement of these deep layers must be exceedingly slow, and as we know practically nothing of the life history of these deep sea forms, we do not know to what extent their motile larval stages are passed in this deep layer rather than in the surface ones where the distribution resulting from water movements would be very different. If and when the "Glaucothoe problem" is solved it may throw some light on this aspect of distribution.

I wish to thank Col. R. B. Seymour Sewell and the Committee of the John Murray Expedition for the opportunity of examining this collection.

* Since this paper was written, Sewell (1940) has discussed the possible dependence of the distribution of marine organisms on water movement with particular reference to the Indian Ocean.

LIST OF SPECIES COLLECTED.

PAGURIDEA.

PAGURIDÆ.

PAGURINÆ.

- Paguroopsis typicus* Henderson. Station 106.
Paguristes balinophilus Alcock. Station 72.
P. pusillus Henderson. Stations 72 and 45.
P. hians Henderson. Station 45.
P. incomitatus Alcock. Stations 164 and 194.
Calcinus elegans (Milne-Edwards). Station 27.
Diogenes rectimanus Miers. Station 27.
D. bicristimanus Alcock. Station M.B. 11A.
Troglopagurus jousseaumei Bouvier. Station 72.
Pagurus euopsis Dana. Station 27.
P. asper DeHaan. Stations 27 and 146.
P. hessii Miers. Stations 72, and "B," Red Sea.
Aniculus tenebrarum Alcock. Station 177.
A. strigatus (Herbst). Station 45.

EUPAGURINÆ.

- Parapagurus pilosimanus* S. I. Smith. Stations 26, 118, 119, 120, 162, 171, 184 and 185.
P. minutus Henderson. Station 143.
P. andersoni Henderson. Stations 119, 122 and 143.
Sympagurus bicristatus S. I. Smith. Stations 34, 105, 109, 143, 145, 164, 184 and 195.
S. burkenroadi sp. nov. Station 115.
Glaucothoe hendersoni Bouvier. Stations 119 and 143.
Nematopagurus muricatus (Henderson). Station 157.
? Eupagurus macardlei Alcock. Station 72.
Eupagurus carpofoaminatus Alcock. Stations 45, 53 and 72.
Pylopaguroopsis magnimanus (Henderson). Stations 24, 72 and 194.

COENOBITIDÆ.

- Cœnobita clypeatus* Latreille. Shore collection, Maldives.
C. perlatus Milne-Edwards. Shore collection, Red Sea and S. Arabian coast.

PAGURIDEA.

PAGURIDÆ Dana.

Sub-family PAGURINÆ Ortmann.

Genus *Paguropsis* Henderson.*Paguropsis typica* Henderson.

Paguropsis typicus Henderson, 1888, p. 99, pl. x, fig. 4.

Paguropsis typica Alcock, 1905, p. 28.

OCCURRENCE.—Station 106. Zanzibar region. 212 metres. Agassiz trawl. 2 specimens (19 and 14 mm. long).*

RANGE.—Philippine Islands, Gulf of Martaban, Cape Comorin and Zanzibar region (new loc.). 183 to 212 metres.

NOTES.—The present specimens are scarcely one-third the size of those recorded by Alcock, but only slightly smaller than Henderson's type material. The hand in these specimens is rather more spiny than that figured by Henderson, but otherwise they agree well with that author's description.

REMARKS.—It is interesting to contrast the extremely narrow depth range of this species with its very wide geographical distribution. All four records that I have been able to trace are from green mud.

Genus *Paguristes* Dana.*Paguristes balinophilus* Alcock.

Paguristes balinophilus Alcock, 1905, p. 33, pl. iii, fig. 1.

OCCURRENCE.—Station 72. Gulf of Oman. 2 specimens (38 and 30 mm.).

RANGE.—Andamans, Gulf of Oman (new loc.), and off Bombay. 70 to 110 metres.

NOTES.—As Alcock has remarked, this species is hardly separable from the Atlantic and Mediterranean species, *P. oculatus* Fabr.

Paguristes pusillus Henderson.

Paguristes pusillus Henderson, 1896, pt. 2, p. 526.

OCCURRENCE :

Station 45. South Arabian coast. 38 metres. 5 specimens (30–18 mm.).

Station 72. Gulf of Oman. 73 metres. 1 specimen (21 mm.).

RANGE.—North-east coast of Ceylon, South Arabian coast (new loc.) and Gulf of Oman (new loc.). 38 to 80 metres.

NOTES.—The single specimen from Station 72 differs from the original description in having the hands rather longer, but there is no other difference.

REMARKS.—Of the five specimens taken at Station 45, three are ovigerous.

* Throughout this paper the lengths of animals are measured from the anterior median border (rostrum) of the carapace to the distal end of the telson with the animal stretched straight. These measurements should not be regarded as more than an indication of the size.

Paguristes hians Henderson.

Paguristes hians Henderson, 1888, p. 79, pl. viii, fig. 4.

OCCURRENCE.—Station 45. South Arabian coast. 38 metres. 2 specimens (13 mm.).

RANGE.—Philippine Islands, Bay of Bengal, South Arabian coast (new loc.). 30 to 50 metres.

Paguristes incommitatus Alcock.

Paguristes incommitatus Alcock, 1905, p. 39, pl. iii, fig. 6.

OCCURRENCE :

Station 164. Maldive area. 183 metres. 6 specimens (17–8 mm.).

Station 194. Gulf of Aden. 220 metres. 23 specimens (19–10 mm.).

RANGE.—Bay of Bengal, Maldive area (new loc.), Gulf of Aden (new loc.). 183 to 220 metres.

REMARKS.—Many of the females from Station 194 were ovigerous.

Genus *Calcinus* Dana.*Calcinus elegans* (Milne-Edwards).

Pagurus elegans Milne-Edwards, 1836, p. 278, pl. xiii, figs. 2 and 3.

Calcinus elegans Dana, 1852, p. 458, pl. xxvii, fig. 10.

OCCURRENCE.—Station 27. Gulf of Aden, 37 to 91 metres. 1 specimen (9 mm.).

RANGE.—Gulf of Aden (new loc.), Laccadives, "South Seas", Indo-Pacific from S.E. and E. Africa to the Sandwich Islands (? Pacific coast of Patagonia).

NOTES.—This specimen agrees perfectly with Alcock's description except that the colour is not so deep nor the pattern so well marked.

Genus *Diogenes* Dana.*Diogenes rectimanus* Miers.

Diogenes rectimanus Miers, 1884, p. 262, pl. xxvii, fig. c.

OCCURRENCE.—Station 27. Gulf of Aden. 37 to 91 metres. 2 specimens (15 and 11 mm.).

RANGE.—Gulf of Aden (new loc.), east coast of India, North Australia. 37 to 120 metres.

Diogenes bicristimanus Alcock.

Diogenes bicristimanus Alcock, 1905, p. 72, pl. vii, fig. 1.

OCCURRENCE.—Motor boat Station 11A. South Arabian coast. 9 metres. 1 specimen.

RANGE.—South Arabian coast (new loc.), Indus delta, Ganjam coast, South African coast. 9 to 61 metres.

Genus *Troglopagurus* Henderson.

Troglopagurus jousseaumei Bouvier.

Troglopagurus jousseaumei Bouvier, 1897, p. 232, fig. 6.

OCCURRENCE.—Station 72. Gulf of Oman. 73 metres. 18 specimens (22–16 mm.).

RANGE.—Persian Gulf, Gulf of Oman (new loc.), off west coast of India.

REMARKS.—Many of the females with eggs.

Genus *Pagurus* Fabr.

Pagurus euopsis Dana.

Pagurus euopsis Dana, 1852, p. 7.

OCCURRENCE.—Station 27. Gulf of Aden. 37 to 91 metres. 2 specimens (21–18 mm.).

RANGE.—Red Sea, Gulf of Aden (new loc.), east coast of Africa, and eastward through the Indo-Pacific to Samoa.

NOTES.—Both the specimens are in so bad a state of preservation that the identification is not absolutely certain.

Pagurus asper DeHaan.

Pagurus asper DeHaan, 1849, p. 208, pl. xlix, fig. 4.

OCCURRENCE :

Station 27. Gulf of Aden. 37 to 91 metres. 2 specimens (40 and 35 mm.), badly damaged.

Station 146. Maldive area. 37 metres. 1 specimen (65 mm.).

RANGE.—Gulf of Aden (new loc.), Maldives, Ceylon, Andamans, Malay Archipelago, Loyalty Islands, Sandwich Islands, Japan, Australia.

Pagurus hessii Miers.

Pagurus hessii Miers, 1884, pp. 185, 264, pl. xxviii, fig. A.

OCCURRENCE :

Station "B" (date, 17.ix.33). Red Sea. 29 metres. 2 small specimens.

Station 72. Gulf of Oman. 73 metres. 14 specimens (65–16 mm.).

RANGE.—Red Sea (new loc.), Gulf of Oman (new loc.), Maldives, east coast of India, Bay of Bengal, Burma coast, Penang, Celebes Sea.

NOTES.—The relative length of the eye stalk* to the antennular peduncle seems to be rather a variable character.

Genus *Aniculus* Dana.

Aniculus tenebrarum Alcock.

Aniculus tenebrarum Alcock, 1905, p. 96, pl. vii, fig. 5.

OCCURRENCE.—Station 177. Gulf of Aden. 274 to 366 metres. 1 specimen (14 mm.).

RANGE.—Cape Comorin, 185 metres (single record). Gulf of Aden (new loc.).

* Throughout this paper in considering either the length or the breadth, the eyestalk is taken as including the eye itself.

Aniculus strigatus (Herbst).*Cancer strigatus* Herbst, 1804, p. 25, pl. lxi, fig. 3.*Aniculus strigatus* Henderson, 1893, p. 422.

OCCURRENCE.—Station 45. South Arabian coast. 38 metres. 1 specimen (20 mm.).

RANGE.—Mozambique, Gulf of Aden, South Arabian coast (new loc.), S.W. Indian coast and Bay of Bengal, Loyalty Islands, and Tahiti.

Sub-family EUPAGURINÆ Ortmann.

Genus *Parapagurus* S. I. Smith.*Parapagurus pilosimanus* S. I. Smith.*Parapagurus pilosimanus* S. I. Smith, 1879, p. 51.

OCCURRENCE :

Station 26. Gulf of Aden. 2312 metres. 4 specimens (20–10 mm.).

Station 118. Zanzibar area (new loc.). 1789 metres. 18 specimens (35–11 mm.).

Station 119. Zanzibar area (new loc.). 1207 to 1463 metres. 4 specimens (18–10 mm.).

Station 120. Zanzibar area (new loc.). 2926 metres. 4 specimens (20–10 mm.).

Station 162. Maldivé area. 1829 to 2051 metres. 2 specimens (23 mm.).

Station 171. Central part of the Arabian Sea. 3840 to 3872 metres. 4 specimens (20–8 mm.).

Station 184. Gulf of Aden (new loc.). 1270 metres. 5 specimens (20–8 mm.).

Station 185. Gulf of Aden (new loc.). 2000 metres. 1 specimen (8 mm.).

RANGE.—In deep water in all the oceans of the world. In the North Atlantic there are records from as shallow as 450 metres, but most records fall between 1500 and 3500 metres.

NOTES.—Specimens from the different oceans often differ somewhat from Smith's description; but the variation among individuals from the same locality both in this collection and in others which I have seen is about the same as that between those from different localities; and I have been unable to find any constant separating characters. Specimens which I have seen from the coast of Ireland and the North Eastern Atlantic generally are larger and more hairy than any I have seen from the Indian Ocean.

REMARKS.—This species has always been recorded as housed in a very typical zoophyte growth. Of the present specimens, none had this characteristic housing. Quite a number of shells had been used, of which the most common was a species of *Ianthina*. It should be remembered that the typical zoophyte house begins as the covering of a mollusc shell, and in two specimens that I have examined from the North Atlantic, the shell was *Ianthina* sp.

There were ovigerous females among the specimens at Stations 26 and 171.

Parapagurus minutus Henderson.*Parapagurus minutus* Henderson, 1896, p. 531.

OCCURRENCE.—Station 143. Maldivé area. 797 metres. 1 specimen (14 mm.).

RANGE.—Maldivé area. 797 to 1295 metres.

REMARKS.—As was the case with Henderson's specimens, this specimen was found in a *Dentalium* shell.

Parapagurus andersoni Henderson.

Parapagurus andersoni Henderson, 1896, p. 529.

OCCURRENCE.—

Station 119. Zanzibar area. 1207 to 1463 metres. 1 specimen (14 mm.).

Station 122. Zanzibar area. 732 metres. 2 specimens (23 and 21 mm.).

Station 143. Maldive area. 797 metres. 5 specimens (30–18 mm.).

RANGE.—Between Maldives and Cape Comorin. 797 to 1390 metres. Zanzibar area (new loc.). 732 to 1463 metres. East African coast. 693 to 1242 metres.

REMARKS.—At both Stations 122 and 143 there was an ovigerous female.

Genus *Sympagurus* S. I. Smith.

It has been repeatedly pointed out that this genus differs from *Parapagurus* only in the gill structure. Milne-Edwards and Bouvier (1893, p. 58) suggested that it might be combined with *Parapagurus*, a step which was taken by Balss (1912, p. 98). Bouvier (1922, p. 21) has re-separated them and I have followed him in this.

Sympagurus bicristatus (A. Milne-Edwards and Bouvier).

? *Eupagurus bicristatus* Milne-Edwards, 1880, p. 43.

Sympagurus bicristatus Milne-Edwards and Bouvier, 1892, p. 205.

OCCURRENCE :

Station 34. Gulf of Aden. 1022 metres. 3 specimens (16–13 mm.).

Station 184. Gulf of Aden. 1270 metres. 1 specimen (10 mm.).

? Station 195. Gulf of Aden. 1095 metres. (Chela only.)

Station 105. Zanzibar area. 380 metres. 2 specimens (10 mm.).

Station 109. Zanzibar area. 640 metres. 3 specimens (12–8 mm.).

Station 143. Maldive area. 797 metres. 8 specimens (12–7 mm.).

Station 145. Maldive area. 494 metres. 15 specimens (23–12 mm.).

Station 164. Maldive area. 183 metres. 1 specimen (20 mm.).

RANGE.—Caribbean Sea, western Atlantic, from the Azores and coast of Portugal to Cape Verde, Gulf of Aden, Maldive area, east African coast. Depth from 99 metres to 1642 metres.

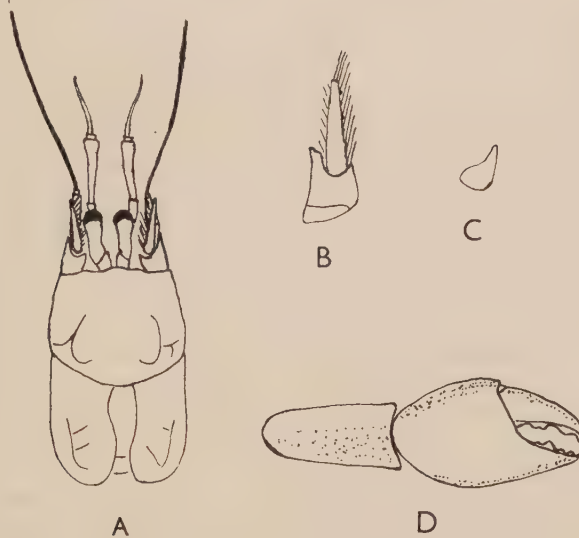
NOTES.—Alcock (1905, p. 105) has divided his material from the Indian seas into the variety *typica* and the variety *indicus*. In the present fairly large collection I have found this species very variable, particularly in the shape of the hand and in the development of the two crests on it. Balss (1912, p. 99) has already remarked on this fact. The variations grade into one another to such an extent that I have not felt able to distinguish between the two sub-species; but it should be noted that, as the depth range of this species is unusually great, it seems to me quite possible that a careful examination of large collections would result in the division of this species into as many as three species.

Sympagurus burkenroadi sp. nov. (Text-fig. 1.)

OCCURRENCE.—Station 115. Zanzibar area. 640 to 658 metres. 3 specimens (50–31 mm.).

DESCRIPTION.—Carapace strongly calcified in front of the well-defined cervical groove but rather less so in the anterior median dorsal region. Behind the cervical groove the carapace is membranous. The greatest breadth in the branchial region is about two-thirds the length in the middle line. The rostrum, though almost obsolescent, is faintly carinate and more prominent than the antennal angles.

The eye stalks are stout, expanded both proximally and distally, and are a little more than half the length of the anterior border of the carapace; they reach to the middle of



TEXT-FIG. 1.—*Sympagurus burkenroadi*, nov. sp. All views are from above. A. Cephalothorax ($\times 1.5$). B. Left antennal acicle ($\times 3$). C. Left ophthalmic scale ($\times 4$). D. Right hand and carpus ($\times 1$).

the penultimate joint of the antennular peduncle and of the last joint of the antennal peduncle. They have a sparse row of long hairs dorsally. The ophthalmic scales are well separated at their base and each is produced to a single acute spine on its inner border.

The antennular peduncles are a little more than three-quarters of the length of the carapace and of this length about two-thirds is made up of the terminal joint. The antennal peduncle extends just past the end of the eye stalks. The acicle is almost straight and narrowly triangular, reaching to the distal end of the last joint of the peduncle. The outer border is smooth with a little hair; the inner border has some small spines and a thick fringe of long hairs. The antennal flagellum is about one and three-quarter times the length of the body.

The chelipeds are very unequal, the right being not only longer but much more massive. Both right and left chelipeds have the hand and carpus so densely pilose as to conceal

not only the sculpture, but the shape of the hand and the carpus. These hairs are rather fine, forming a soft, fluffy-looking covering about 2 mm. thick. The large cheliped is nearly three times the length of the carapace. The hand is hardly half as wide as long, the dactylus being half the length of the hand. The surface of the hand, when exposed by depilation, has a glazed-white appearance, quite devoid of sculpture except that on the margins of the face there is a rounded ridge of small granular spines. The ridge disappears before reaching the dactylus, but the granules continue on along the outer edge of the finger. The outer edge of the palm has a thin row of small spines which extend up along the fixed finger. Both margins of the upper surface of the hand are rather rounded and ill-defined. The carpus is three-quarters the length of the hand. It is almost cylindrical in shape and its greatest width is only half its length. Except for small granules on its upper and outer face it is free from sculpture, and is equal in length to the next two joints combined.

The second and third legs of both sides are about equal in length and hardly surpass the large cheliped when both are stretched out. All the joints are smooth except for a small spine on the distal end of the carpus. The dactyli are plumose distally. The dactyli of the left side are scarcely and those of the right side distinctly shorter than the corresponding combined propus and carpus.

REMARKS.—The holotype and the two paratypes are from Station 115. The holotype is a male, about 50 mm. in length, and the two paratypes are both females, one a large mature ovigerous specimen (about 48 mm.) and the other a small one (31 mm.). Apart from the sexual differences common to the genus, the paratypes agree well with the holotype. The only noteworthy differences are that there is a tendency for the branchial region to be rather more expanded and that all the joints of the chelipeds are shorter. The proportions are, however, but little altered. It is worth noting that the female genital aperture was found only on the left-hand side. It has been necessary to depilate the chelipeds of the holotype in order to examine their shape and structure, and to some extent this had been done in the case of the larger female. A good idea of the original general appearance can be obtained from Balss' photograph (1912, pl. x, fig. 3) of what he has called *Parapagurus arcuatus* var. *monstrosa*.

This species is very close to *Sympagurus arcuatus* Milne-Edwards and Bouvier, var. *monstrosus* Alcock, from which it is readily separated by the densely pilose condition of both its chelipeds, by the shape and sculpture of its large hand, and by the narrow, almost cylindrical shape of its carpus. Other points of difference are the slightly greater length of its eye stalks, the shape of its antennal acicle, its shorter antennal flagellum, the relatively greater length of its large cheliped, and that its walking legs of both sides are of almost equal length and scarcely surpass the large cheliped. From *Sympagurus arcuatus* it is immediately separated by the shape of its large hand, which is absolutely different from that figured by Milne-Edwards and Bouvier (1893, pl. v, fig. 22). I am very doubtful whether the specimen figured by Balss (*loc. cit.*) is the same as Alcock's variety with which he has identified it; he gives no description, and it is impossible to tell the amount of distortion that has taken place in this photograph, and the possible identification of this form with the present species must wait till the specimens have been compared. At least one of Balss' specimens came from the same region as the present specimens.

This species is named after Mr. M. D. Burkenroad, of the Bingham Oceanographic Laboratory, Yale University.

Glaucothoe Milne-Edwards.*Glaucothoe hendersoni* Bouvier. (Text-figs. 2 and 3.)*Glaucothoe* Henderson, 1896, p. 535.*Glaucothoe* sp. prox. *peronii* Alcock, 1905, p. 23.*Glaucothoe hendersoni* Bouvier, 1905, p. 6.

OCCURRENCE :

Station 119. Zanzibar area (new loc.). 1207 to 1463 metres. 1 specimen (21 mm.).

Station 143. Maldiva area (new loc.). 797 metres. 2 specimens (19–20 mm.).

RANGE.—Between Cape Comorin and Maldives, 1295 metres. Maldiva area, 797 metres. Zanzibar area, 1207 to 1462 metres.

DESCRIPTION.—The anterior border of the carapace is produced into a broadly triangular, subacute process, reaching well out between the bases of the ocular peduncles. The carapace is roughly rectangular, there being hardly any expansion over the branchial region. The cervical groove is deeply cut, and the portion of the carapace that is included within it is strongly calcified and notably arched. The cardiac region is also well calcified, but the branchial region is thin and almost transparent. The greatest width of the carapace is about three-quarters of its length in the middle line.

The eye stalks are almost exactly half as long as the anterior border of the carapace. They reach just beyond the penultimate joint of the antennular peduncle and are about equal in length to the antennal peduncle. There is no sign of an ophthalmic scale. The eye stalks are greatly enlarged anteriorly, so that their greatest width is about two-thirds of their length. The eyes themselves are concave at their ends, and are almost unpigmented; what little pigment there is is concentrated towards the anterior inner portion of the eye.

The antennular peduncles are only moderately stout. Their length is about two-thirds of the carapace in the middle line, more than half of which is made up of the terminal joint.

The antennal peduncles have a simple narrowly lobe-shaped acicle which reaches almost to the end of the penultimate joint. The flagellum is about twice the length of the carapace.

The chelipeds are very unequal, the right one not only being longer but vastly more massive. Measured on the arc, the large (right) cheliped is about twice as long as the carapace measured in the middle line. The large hand (including the fixed finger) is about twice as long as broad, and the dactylus is about half as long as the hand. The outer surface of the hand is practically free from sculpture except along the two margins; here there are a number of small granules and these extend on along both the fixed finger and the dactylus. There is some hair on this surface and on the carpus, but not enough to obscure the surface and the sculpture in the least. The cutting edge of both the fixed and movable fingers have a few, rather irregular large white teeth. The carpus about equals the palm in length, and on its upper border there is a row of small teeth.

The small cheliped reaches about to the base of the dactylus of the large hand. The small hand is narrow and rather slight. The chelipeds open and close obliquely.

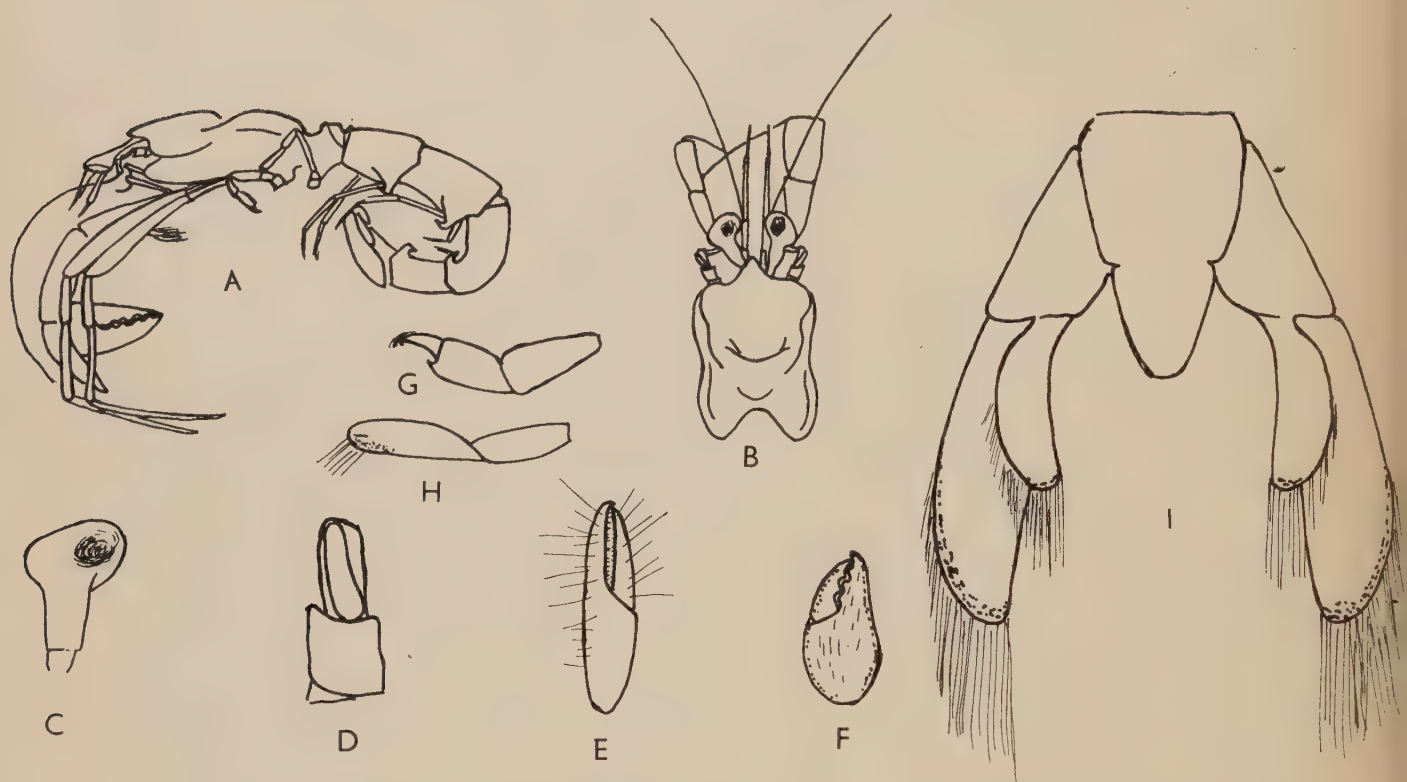
The walking legs surpass the large cheliped by about half the length of their dactylus when they are all stretched out.

The 4th pair of legs are sub-chelate and the 5th pair minutely chelate.

The abdomen is about two and a quarter times the length of the carapace, and the segmentation is very clearly shown. The first abdominal segment has an incomplete tergum; the terga of all the remaining abdominal segments are complete, but poorly calcified. Segments 2 to 5 each bears a pair of appendages, and has the epimeron of each side produced downwards into a procurved hook.

The abdomen is twisted up on the right side as in the typical pagurid adult, but the tail fan is still symmetrical.

The mouth parts seem to be those of the typical adult pagurid (Fig. 3), and the third maxillipeds are well separated at their base.



TEXT-FIG. 2.—*Glaucothoe*. A. Left lateral view ($\times 3.75$). B. Dorsal view of cephalothorax ($\times 3.5$). C. Left eye from above ($\times 8$). D. Base of left antennae, showing shape of acicle ($\times 17.5$). E. Outer surface of left hand ($\times 6$). F. Outer surface of right hand ($\times 4$). G. Last three joints 4th leg, left side ($\times 15$). H. Last three joints 5th leg, left side ($\times 15$). I. Telson and tail fan ($\times 22.5$).

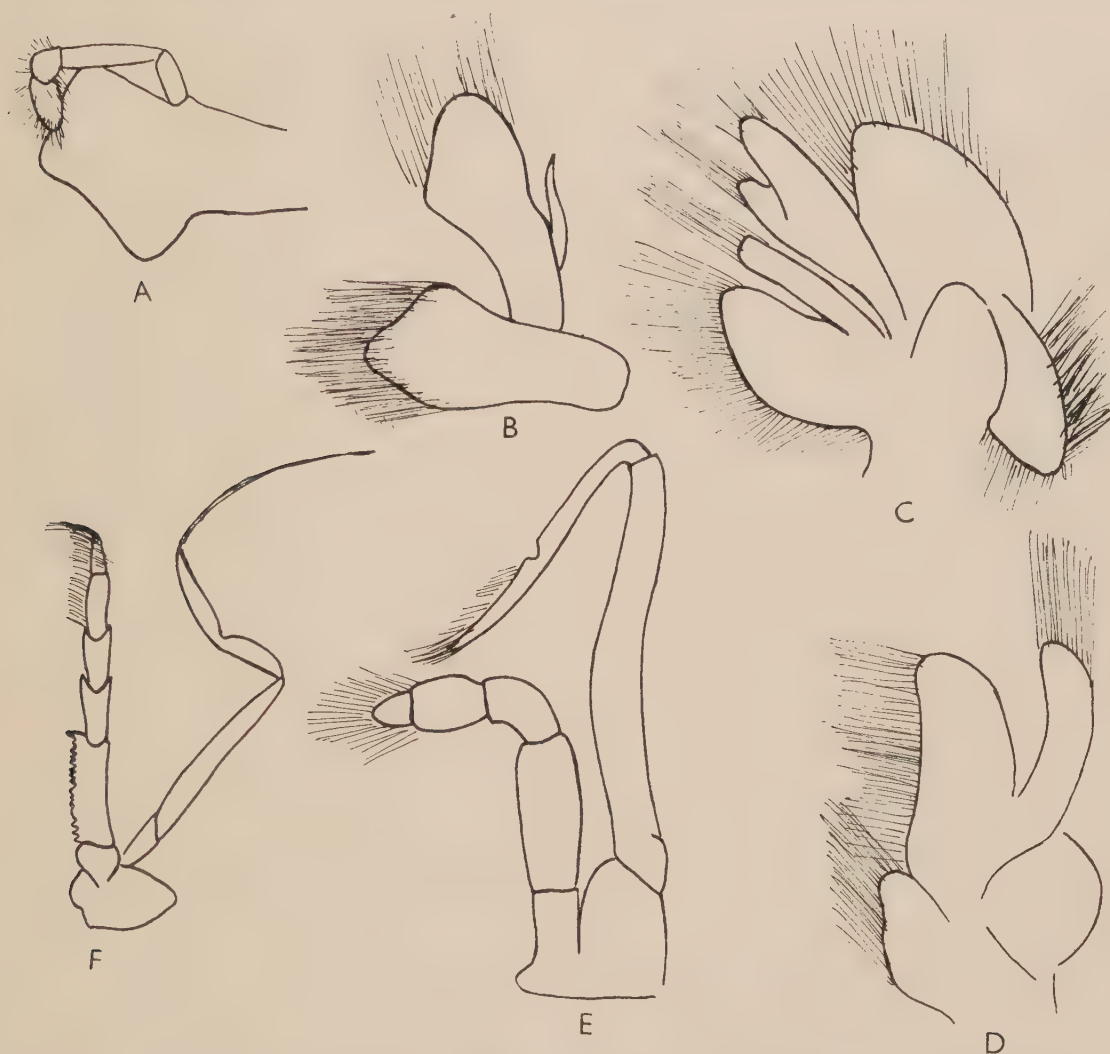
The gill formula is the same as that described by Gurney (1924, p. 185). However, only the anterior pair is rudimentary, the other gills being well developed.

No genital apertures could be detected.

NOTES.—It is with some hesitation that I have referred these specimens to *G. hendersoni*. Henderson's original description and Alcock's subsequent remarks were based on "a single specimen . . . not in a fit condition for description or figuring". Milne-Edwards' description of *Glaucothoe peronii* is not very complete, but as far as it goes it agrees with my specimens except for the more prominent rostrum and granulose hand; and these latter are the characters on which Bouvier (1905, p. 5) has separated *Glaucothoe*

hendersoni from *Glaucothoe peronii* and it seems certain that Bouvier never saw Henderson's specimen.

REMARKS.—The most interesting feature of these specimens is that while they still retain the larval characters on which the "Genus" *Glaucothoe* was originally based (*e. g.* absence of ophthalmic scale, paired abdominal appendages and symmetrical tail fan) they appear to have developed further towards adult pagurids than any specimens previously recorded. Thus, the tail, though still symmetrical, is curled up on the side in the typical



TEXT-FIG. 3.—*Glaucothoe*. Mouth parts from the left side. A. Mandible ($\times 50$). B. 1st Maxilla ($\times 50$). C. 2nd Maxilla ($\times 50$). D. 1st Maxilliped ($\times 50$). E. 2nd Maxilliped ($\times 37.5$). F. 3rd Maxilliped ($\times 37.5$).

adult form; and all three specimens were found inhabiting gastropod shells, suggesting that they are about to assume the adult way of life.

The original dispute as to whether members of the "Genus" *Glaucothoe* were adult animals or larval stages seems to have been pretty well settled by Bouvier (1891 and 1905) in favour of their being larval stages of various pagurids. We are still left with the question as to whether the large *Glaucothoes* are normal or abnormal forms. Bouvier

(1905) holds to the former view, maintaining that these large *Glaucothoes* are merely small ones which failed to find a shell at the proper time and continued to grow in the larval state. Gurney (1924) prefers to consider them as normal stages in the development of pagurids, the life histories of which are as yet unknown. There is still little evidence on which to decide between these opinions. It seems relevant to point out that many workers have shown that in the development of pagurids the assumption of the asymmetric form appears before a shell is found, and it is, therefore, difficult to explain the continued symmetry in the large *Glaucothoes* simply on the grounds that they have failed to find a suitable shell. To explain this failure to metamorphose to the asymmetric form we must postulate a difference in the life history of these forms from that of the known pagurids; and as we have to postulate this difference, it seems better to go all the way and agree with Gurney that the large *Glaucothoes* represent normal stages in development.

As *Glaucothoes* attain relatively large size it is obvious that, if we assume that they represent normal stages in development, they must be the larvæ of rather large adults. In the case of the present specimens, if they are normal larvae of known genera, the adults undoubtedly belong to the Genus *Sympagurus*. A comparison of the description given here for *Glaucothoe hendersoni* with that given for *Sympagurus burkenroadi* is interesting. Except for the characters which can be fairly accepted as larval, the descriptions are practically interchangeable. Further, the specimens of *Sympagurus burkenroadi* were taken at Station 115, quite close to Station 119, where one specimen of *Glaucothoe hendersoni* was found, inhabiting the same species of shell as that used by *S. burkenroadi*. This is nothing more than a suggestion, but I do not know of any other pagurid which in size, habitat and structure could so well be the adult of this form.

Genus *Nematopagurus* Milne-Edwards and Bouvier.

Nematopagurus muricatus (Henderson).

Catapagurus muricatus Henderson, 1896, p. 524.

Nematopagurus muricatus Alcock, 1905, p. 111.

OCCURRENCE.—Station 157. Maldive area. 229 metres. 2 specimens (20 mm.).

RANGE.—North-east and south coast of Ceylon (50 to 60 metres). Maldive area (new loc., 229 metres).

NOTES.—These specimens have rather more spines on the hands than is shown in Alcock's figure, but otherwise agree well with his description.

Genus *Eupagurus* Brandt.

Eupagurus macardlei Alcock.

Eupagurus macardlei Alcock, 1905, p. 129, pl. xi, fig. 3.

OCCURRENCE.—Station 72. Gulf of Oman. 73 metres. 3 specimens (35, 14, and 8 mm.).

RANGE.—Persian Gulf. 72 metres. Gulf of Oman (new loc.). 73 metres.

NOTES.—All three specimens are in a very poor state of preservation, so that this identification is not at all certain.

Eupagurus carpofoaminatus Alcock.*Eupagurus carpofoaminatus* Alcock, 1905, p. 130.

OCCURRENCE :

Station 45. South Arabian coast. 38 metres. 6 specimens (25–15 mm.).

Station 53. South Arabian coast. 13·5 metres. 1 specimen (16 mm.).

Station 72. Gulf of Oman. 73 metres. 5 specimens (23 mm.).

RANGE.—Along the South Arabian coast (new loc.), including the Gulf of Oman (new loc.), down the west Indian coast to Ceylon and up the east coast of India to the head of the Bay of Bengal. 13·5 to 266 metres.

REMARKS.—Some of the females at Station 72 were ovigerous.

Genus *Pylopaguropsis* Alcock.*Pylopaguropsis magnimanus* (Henderson).*Pylopagurus magnimanus* Henderson, 1896, p. 522.*Pylopaguropsis magnimanus* Alcock, 1905, p. 134, pl. xiii, fig. 2.

OCCURRENCE :

Station 72. Gulf of Oman (new loc.). 73 metres. 1 specimen (16 mm.).

? Station 24. Gulf of Aden (new loc.). 73 to 220 metres. 1 broken specimen (15 mm.).

? Station 194. Gulf of Aden (new loc.). 220 metres. 2 broken specimens (about 26 mm.).

RANGE.—From the head of the Bay of Bengal down the east coast of India to Ceylon. 109 to 395 metres. Gulf of Oman (new loc.). 73 metres. Gulf of Aden (new loc.). 73 to 220 metres ?

NOTES.—The specimens from the Gulf of Aden are in such bad condition that the determinations are not at all satisfactory.

Family COENOBITIDÆ Dana.

REMARKS.—As the members of this family are land or littoral forms the specimens in the present collection are the result of casual shore collections, and are in no way representative of the Coenobitidæ fauna of the areas visited.

Family COENOBITA Latreille.

Coenobita clypeatus Latreille.*Coenobita clypeata* Latreille, 1826, p. 277.*Coenobita clypeatus* Alcock, 1905, p. 142, pl. xv, fig. 1, 1a.

OCCURRENCE.—One large specimen from on shore at Horseburgh Atoll (Maldives).

RANGE.—Tropical West Africa. From tropical East Africa through the Indo-Pacific to Tahiti. Usually well above high-water mark.

REMARKS.—This specimen was inhabiting the half of a small coconut shell.

Coenobita perlatus Milne-Edwards.*Coenobita perlata* Milne-Edwards, 1837, p. 242.*Coenobita perlatus* Ortmann, 1892, p. 319, pl. xii, fig. 25.

OCCURRENCE.—Shore collection Zuhaw Island (Red Sea). 6 specimens (about 40

mm.). A very common species in this locality. Shore collection, Beach Island, Hallaneya, Khorya Morya; South Arabian coast. 1 specimen (about 50 mm.), but it was very common there.

RANGE.—Red Sea. South Arabian coast, Mauritius, Seychelles through the Indo-Pacific to Samoa; just at high-water springs.

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